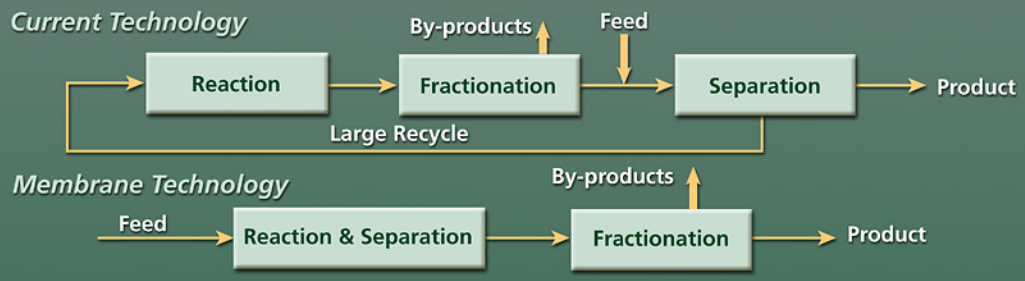
Advanced Inorganic Membranes Impact Chemical and Petrochemical Industries

Composite Inorganic Thin Films can result in increased energy efficiency and reduced capital expenditure for the production of hydrocarbon chemicals

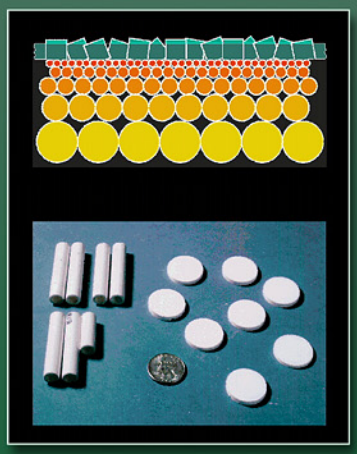
Objective: Develop novel composite zeolite/amorphous membranes for hydrocarbon separations

Benefits:
- enable separations involving similarly shaped and sized molecules (gases, hydrocarbons) at high temperatures
- large energy savings ~100 trillion BTU/yr; ~75% reduction
- Lower capital expenditures ~60% reduction

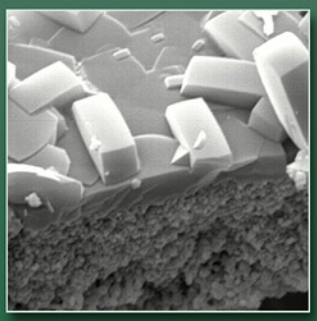
Energy Efficient Separations Process



Energy-efficient separation process involving novel microporous inorganic thin film materials can lead to improved energy savings compared to conventional adsorption or cryogenic processes

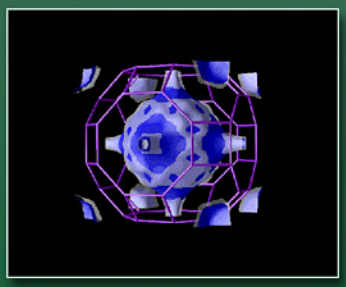


Membrane schematic (top), and Ceramic supports (bottom)



Supported oriented crystalline Zeolite thin film

Isopotential surfaces for H_2 and CH_4 in Zinc phosphate help define mechanisms
– Zinc phosphate–wireframe
– CH_4 isosurface is opaque blue
– H_2 isosurface is transparent and white



Status:
- successfully synthesized defect-free zeolite/amorphous composite film membranes on various substrates
- synthesized highly oriented zeolite crystalline supported membranes
- films are thermally stable to >500°C

Partners:

BP · AMOCO · COORS TECHNICAL CERAMICS

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Advanced Materials for Reducing Energy Consumption and Manufacturing Costs in the Chemicals and Petroleum Refining Industries

A technology breakthrough in separation processing is crucial to the U.S. hydrocarbon industry, as it would result in yearly energy savings of ***about 105 trillion BTUs by the year 2020***. Improved hydrocarbon-gas separation processes will reduce U.S. energy requirements and dependence on oil imports. This key separation area is currently conducted primarily by cryogenic distillation; extremely low temperatures (-90°C) and corresponding high refrigeration costs and high compressor utility charges characterize this process. Energy-efficient separation processes involving novel microporous inorganic thin film materials can lead to significant energy savings compared to conventional adsorption or cryogenic processes. ***The end effect would be about 75% energy reduction in hydrocarbon production and about 60% capital reduction.***

This project has the following objectives: (1) the development of novel membrane materials that are tailored to separate hydrocarbon mixtures; (2) the design of a commercially-scalable, economically and technically feasible pilot plant module that uses uniquely optimized, microporous membrane elements to separate hydrocarbon molecules from a typical mixed stream; and (3) formulation of a material and process development program that can be applied to other commercial separation opportunities in the chemicals and petroleum refining industries.

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